Prevalence of psychiatric morbidity and psychological adaptation of the nurses in a structured SARS caring unit during outbreak: A prospective and periodic assessment study in Taiwan ☆

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Abstract

To assess the rapidly changing psychological status of nurses during the acute phase of the 2003 SARS outbreak, we conducted a prospective and periodic evaluation of psychiatric morbidity and psychological adaptation among nurses in SARS units and non-SARS units. Nurse participants were from two SARS units (regular SARS [$N = 44$] and SARS ICU [$N = 26$]) and two non-SARS units (Neurology [$N = 15$] and CCU [$N = 17$]). Participants periodically self-evaluated their depression, anxiety, post-traumatic stress symptoms, sleep disturbance, attitude towards SARS and family support. Results showed that depression (38.5% vs. 3.1%) and insomnia (37% vs. 9.7%) were, respectively, greater in the SARS unit nurses than the non-SARS unit nurses. No difference between these two groups was found in the prevalence of post-traumatic stress symptoms (33% vs. 18.7%), yet, three unit subjects (SARS ICU, SARS regular and Neurology) had significantly higher rate than those in CCU (29.7% vs. 11.8%, respectively) ($p < 0.05$). For the SARS unit nurses, significant reduction in mood ratings, insomnia rate and perceived negative feelings as well as increasing knowledge and understanding of SARS at the end of the study (all $p < 0.001$) indicated that a gradual psychological adaptation had occurred. The adjustment of nurses in the more structured SARS ICU environment, where nurses care for even more severely ill patients, may have been as good or better than that of nurses in the regular SARS unit. Occurrence of psychiatric symptoms was linked to direct exposure to SARS patient care, previous mood disorder history, younger age and perceived negative feelings. Positive coping attitude and strong social and family support may have protected against acute stress. In conclusion, the psychological impact on the caring staffs facing future bio-disaster will be minimized with lowered risk factors and a safer and more structured work environment.
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1. Introduction

In the early 21st century, an epidemic of severe acute respiratory syndrome (SARS), a pneumonia-like viral disease, sickened nearly 8000 people worldwide, killing 744 in 2003, according to the World Health Organization (WHO, 2003). Taiwan was not spared from this

global catastrophe. The first case was reported in mid-March and by the end of July 2003, there were 1320 suspected cases and 668 probable cases, and the overall fatality rate was 10.8% (Center for Disease Control and Prevention of Taiwan, 2003). The peak SARS period took place between April 20 and May 27, 2003. Two peak outbreaks occurred during the peak season and both were due to nosocomial transmission. In late April, the SARS infection rate for medical personnel reached 33%, and several of them died of SARS. The percentage of infected health care workers (HCWs) ranged from 3% in the United States (Update SARS-USA, 2003) to as high as 22% in Hong-Kong (Hong Kong Government, 2003) and 51% in Toronto (Booth et al., 2003). The psychological impact of SARS on HCWs was a serious concern at the time of the outbreak and thereafter. The published reports ranged from descriptive and retrospective (Maunder et al., 2004; Maunder, 2004) to systematic evaluations of the psychiatric morbidity and post-traumatic symptoms of HCWs in SARS care environments (Maunder et al., 2004; Sim et al., 2004; Chua et al., 2004; Chan and Huak, 2004; Chen et al., 2005; Chong et al., 2004). Most studies were designed in a cross-sectional manner to assess the stress level (using the impact of event scale, IES) (Horowitz et al., 1979) and psychiatric symptoms (using the general health questionnaire, GHQ-28) (Goldberg, 1978). These studies only estimated the prevalence of psychiatric morbidity and interaction of morbidity with perceived stress and did not longitudinally follow up changes in psychological state in response to caring for SARS patients. There is one prospective study (Cheng et al., 2004) examining the short-term adjustment outcomes among Chinese patients after 1-month recovery from SARS and investigating the risk factors on outcome measures. Our aims were to prospectively and periodically investigate and compare the psychiatric morbidity and to test the hypothesis that the morbidity rate was higher in SARS unit subjects than in those in non-SARS units. In addition, we hypothesized that the severity of mood and sleep symptoms is also greater in SARS ICU subjects than in those in SARS regular unit. We also expected that the psychological distress of the study subjects in the SARS-caring units would gradually diminish as a function of time and return to the level similar to that of the subjects in non-SARS units by the end of the study. Risk factors linked to SARS-related acute stress problems were also identified.

2. Methods

2.1. SARS inpatient units

The two peaks of the SARS outbreak in Taiwan occurred in late April and mid May, 2003. 'Building Ever-Green' located inside Taipei Veterans General Hospital (TVGH), previously used as a geriatric inpatient ward, was converted into a SARS care facility two weeks after the first outbreak of SARS in Taipei City. This SARS inpatient building consisted of four regular SARS units and one SARS intensive care unit (ICU). Patients admitted to SARS ICU suffered from respiratory failure requiring intubation. Each SARS unit, including the ICU, was well equipped and divided into four separate zones (a patient care area, an intermediate buffer zone, a nursing station, and a staff rest area). Medical staff working in the SARS units followed standard operating procedure for infectious disease control. SARS inpatient units were operational on May 14, 2003, just around the time of the second peak of the outbreak in Taiwan.

2.2. Study design

This was a prospective and periodic follow-up design study. All the participants were voluntarily recruited and enrolled into a one-month study during a 7-week period ending June 30, 2003. Behavioral assessment was conducted at baseline and then weekly or biweekly. The protocol of this study was approved by Taipei Veterans General Hospital (TVGH) Institutional Research Board (IRB).

2.3. Behavioral measures

1. Mood symptom ratings were as follows: (1) Beck depression inventory (BDI) for depression (Beck et al., 1961), (2) Spielberger trait anxiety inventory (STAI) for anxiety (Spielberger et al., 1983), and (3) Chinese version of the Davidson trauma scale (DTS-C) for post-traumatic stress symptoms (Chen et al., 2001). To identify cases of symptomatic depression, the criterion was that the BDI score should be 10 or above (mild degree of depression) for any two of the D0, D7, D14, D21 and D28 time points. Symptomatic post-traumatic stress disorder [PTSD; identified on the basis of DTS-C score 23, the cutoff point used to define earthquake-related PTSD (Chen et al., 2001)] was diagnosed at D0, D14, or D28 of the study.

2. Sleep disturbance was indicated by (1) presence of insomnia, defined according to DSM-IV and (2) poor sleep quality, assessed by the Pittsburgh sleep quality index (PSQI, a seven-component index; higher index indicated worsening sleep quality; Buysse et al., 1988). Subjects categorized as insomnia needed to meet both criterion A (either difficulty falling asleep or difficulty maintaining sleep or early morning awakenings) and criterion B (either moderate degree of poor sleep quality or moderate influence of insomnia on daily function) (Su et al., 2004).

3. Attitude scale: A 13-item questionnaire was developed to measure three constructs in evaluating the changes in attitude towards the SARS outbreak in SARS unit subjects: knowledge and understanding of SARS, perceived negative feelings towards SARS, and positive attitudes towards caring for SARS patients. Content validity was established by four experts: a psychiatrist (T.P. Su); a manager in the SARS committee of the institution (C.T. Yang); a SARS nursing care coordinator (Y.L. Su) and a doctoral student of the epidemiology study of disaster (F. Chou). They were asked to rate the relevance and wording of each scale item (rated from 1 to 4). If the item was rated as 1 or 2, it would be deleted or revised, if the item was rated as 3 or 4, it would be revised or kept based on the comments or suggestions. A Likert-type scale was used to evaluate self-rated changes in attitude towards the SARS. Answers were assigned a value of 0 to 3, indicating whether respondents strongly disagree, disagree, agree, or strongly agree with the item. The internal consistency of the scale was evaluated at baseline and reported as the subscale Cronbach's α. Based on the items clustered in different categories, factors of "Knowledge and understanding of SARS" ($\alpha = 0.87$) contained 4 items. Factors of "Perceived negative feelings towards SARS" ($\alpha = 0.82$) contained 6 items. Factors of "Positive attitudes towards caring for SARS patients" ($\alpha = 0.65$) contained 3 items.

4. Sheehan's disability scale (Sheehan et al., 1996) was used to assess impairments in the domains of work, social life/leisure and family life/home responsibility. Each domain is self-rated using Likert 11-point continuum from $0 =$ no impairment to mild (1–3), moderate (4–6), marked (7–9) and to very severe (10).

5. Family APGAR index: a modified Chinese version (Lee et al., 1987) of the Family APGAR index (Smilkstein et al., 1982) contains 5 simple questions indicating 5 dimensions of family function, assessing the supporting relationship from subjects' family. Each question had 4 levels of supporting strength from always (1), to very often (2), to occasional (3) and to rare (4).

BDI, STAI, insomnia and PSQI, and attitude scale were rated weekly while DTS-C was rated biweekly. Sheehan's disability scale and Family APGAR Index were only given twice, each at baseline and the end of the study. The attitude scale, disability scale and family APGAR were only given to SARS unit study subjects.

2.4. Statistics

Data were analyzed using SPSS-PC version 11.0 (SPSS Inc.; Chicago, IL). Repeated-measures ANOVA (ANOVA-R) with polynomial contrast was used for the comparison of ratings of mood and PTSD symptoms, sleep quality, and attitude scores in SARS and non-SARS unit nurses. In the first analysis, treatment group (SARS ICU, regular SARS unit, Neurology unit, and CCU) was the between-subjects factor and time point (D0, D7, D14, D21, and D28) was the within-subjects factor. The second analysis, group (depressed group vs. non-depressed group of SARS unit nurses) was the between-subjects factor while time point was the within-subjects factor. One-way ANOVA with post hoc Bonferroni examination between different groups at various times was used to investigate differences. Fisher exact test was used for categorical variables whenever appropriate. Pearson's linear correlations of mood and PTSD symptom ratings with attitude scale score were made at different times. Multiple logistic regression analyses were carried out to determine the risk factors associated with three psychiatric morbidities (depression, symptomatic PTSD, and insomnia) related to the SARS outbreak. Covariates such as work place (SARS vs. non-SARS unit), past history of mood disorders, age, marital status, years of clinical experience, having children, perceived negative feelings and positive attitudes were entered into the multivariate logistic regression models. All statistical tests were two-sided, and the alpha level was set to be less than 0.05.

3. Results

3.1. Characteristics of subjects

With their written consent, 75 nurses from SARS units (regular [$n = 44$] and SARS ICU [$n = 26$]) and 32 nurses from non-SARS units (cardiac care unit [CCU] [$n = 17$] and Neurology unit [$n = 15$]) participated in the study. Five SARS unit nurses and no non-SARS unit nurses dropped out from this study.

All the participants ($n = 102$) were female and had 14 or more years of education; 73% ($N = 75$) were not married (Table 1). The mean age (25.4 [SD 3.7]) of Neurology unit nurses was significantly lower than that of SARS ICU nurses (31.5 [SD 6.2] years), regular SARS unit nurses (29.8 [SD 7.6] years), and CCU nurses (32.7 [SD 4.3] years) ($p < 0.05$). Similarly, only 20% of the Neurology unit nurses (in contrast to nurses in the other three units) had more than 5 years of working experience.

4. Psychiatric morbidity and clinical course

4.1. Depression symptoms

The prevalence of symptomatic depressed cases during the study period (BDI $\geqslant 10$ for more than 2 weeks)

Table 1
Demographic data among SARS and non-SARS unit subjects

	SARS ICU ($N = 26$)		SARS regular ($N = 44$)		CCU ($N = 17$)		Neurology ($N = 15$)		$F_{3,98}$	p
Age (years) (SD)	31.5 (6.2)		29.8 (7.6)		32.7 (4.3)		25.4[a] (3.7)		4.1	<0.01
	N	$\%$	N	$\%$	N	$\%$	N	$\%$	$X_{3,1}$	p
Not married	9	(35)	9	(21)	7	(41)	2	(13)	4.9	NS
Married	17	(65)	35	(79)	10	(59)	13	(87)		
Having children										
No	4	(15)	7	(16)	7	(41)	2	(13)	6.1	NS
Yes	22	(85)	37	(84)	10	(59)	13	(87)		
Year of experience										
⩽5 years	8	(31)	22	(50)	3	(18)	12	(80)	13.7	<0.005
>5 years	18	(69)	22	(50)	14	(82)	3	(20)		
Past history of depressive disorder (MINI diagnosis)										
No	22	(85)	32	(73)	15	(88)	13	(87)	3.0	NS
Yes	4	(15)	12	(27)	2	(12)	2	(13)		
Current depressive disorder (MINI diagnosis)										
No	21	(81)	37	(84)	17	(100)	15	(100)	6.4	0.1
Yes	5	(19)	7	(16)	0	(0)	0	(0)		

MINI diagnosis: psychiatric diagnosis by Mini International diagnosis for Neuropsychiatric Interview.
[a] Compared to SARS ICU and CCU, $p < 0.05$; NS: non-significant.

(Beck et al., 1988) was 27.5% ($N = 28$) with higher rate in the SARS vs. non-SARS units (38.5%, $N = 27$ vs. 6.7%, $N = 1$, $p < 0.001$). No difference of the prevalence of depression was observed between the nurses of SARS ICU and those of SARS regular unit. Similar finding was also found between nurses working at ICU and in Neurology unit (Table 2).

Significant time effect ($F_{4,95} = 8.3$, $p < 0.001$) and group effect ($F_{3,98} = 4.3$, $p < 0.01$) but no time by group interaction effect (ANOVA-R) were demonstrated on reduction of BDI scores (Table 3), suggesting that depression symptom ratings decreased as the SARS epidemic decreased regardless of which group (SARS vs. non-SARS unit nurses) was assessed. One-way ANOVA revealed a significant group effect on depressive ratings at entry ($F_{3,98} = 3.45$, $p < 0.05$) and the post hoc test showed only the BDI scores of the regular SARS nurses were significantly greater than those of the CCU group

($p < 0.05$). However, at the end of the study, there were no differences in BDI ratings between the groups ($F_{3,98} = 2.56$, $p = $ NS). These findings showed that the nurses working in SARS units in the beginning had modest depression, which gradually diminished to normal levels a month later, while nurses in non-SARS units (particularly the CCU) were not clinically depressed throughout the study period.

4.2. Anxiety symptoms

ANOVA-R demonstrated significant effects of time ($F_{4,95} = 4.4$, $p < 0.001$), group ($F_{3,98} = 2.9$, $p < 0.05$), and time by group interaction ($F_{12,291} = 2.0$, $p < 0.05$) on decreasing STAI scores (Table 3), suggesting anxiety symptoms decreased as a function of time. In addition, significant group effect by one-way ANOVA ($F_{3,98} = 4.38$, $p < 0.01$) revealed that anxiety at entry

Table 2
Prevalence rate of symptomatic depression, PTSD and insomnia of four unit nurses

	SARS ICU ($N = 26$)		SARS regular ($N = 44$)		CCU ($N = 17$)		Neurology ($N = 15$)		X^2	p
	N	$\%$	N	$\%$	N	$\%$	N	$\%$		
Symptomatic depression[a]	10	(38.5)	17	(38.6)	0	(0)	1	(6.7)	14.0	<0.005
Symptomatic PTSD[b]	10	(38.5)	13	(29.5)	2	(11.8)	4	(26.7)	3.7	NS
Insomnia[c]	7	(26.9)	19	(43.2)	0	(0)	3	(20)	12.0	<0.01

NS: non-significant.
[a] Criteria for symptomatic depression: BDI ⩾ 10 for 2 weeks.
[b] Criteria for symptomatic PTSD (post-traumatic stress disorder): DTS-C ⩾ 23 for 1 week.
[c] Criteria for insomnia: insomnia for 2 weeks.

Table 3
Symptom ratings of depression, anxiety, post-traumatic stress symptom and sleep disturbance of the caring nurses at baseline and weekly intervals during SARS outbreak

Nursing units		D0	D7	D14	D21	D28	p		
		Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Time	Group	Time × group
BDI									
SARS ICU	$n = 26$	8.6(6.6)	7.3(6.8)	6.4(5.9)	6.1(6.2)[+]	5.6(5.4)*	<0.001	<0.01	NS
SARS regular	$n = 44$	10.2(6.6)	7.7(6.3)**	7.5(7.7)**	5.4(4.8)***	5.3(5.3)**			
CCU	$n = 15$	5.2(3.2)[c]	3.5(3.4)[+]	2.6(3.3)**	2.1(3.1)**	1.8(2.7)***			
Neurology	$n = 17$	6.7(6.6)	3.1(2.9)*	3.5(3.0)*	4.9(4.3)	3.9(5.3)[+]			
STAI									
SARS ICU	$n = 26$	46.5(12.2)	46.1(11.5)	43.4(10.8)	41.6(9.2)[+]	40.9(10.6)*	<0.001	<0.05	<0.05
SARS regular	$n = 44$	48.4(10.6)	45.3(11.0)**	43.1(10.7)***	40.0(10.4)***	40.0(8.7)***			
CCU	$n = 15$	38.2(7.5)[a,b]	37.4(7.9)	36.6(8.7)	35.9(8.3)	35.9(8.0)			
Neurology	$n = 17$	43.1(8.1)	39.2(7.0)*	43.8(9.8)	43.7(8.9)	43.7(7.8)			
DTS-C									
SARS ICU	$n = 26$	13.3(11.9)		11.4(12.2)		9.4(11.7)	<0.001	NS	NS
SARS regular	$n = 44$	17.6(11.9)		13.0(11.1)		9.8(8.6)***			
CCU	$n = 15$	10.2(7.5)		7.8(7.8)		5.2(8.6)*			
Neurology	$n = 17$	15.2(12.5)		7.3(9.7)		7.9(14.2)[+]			
PSQI									
SARS ICU	$n = 26$	6.0(2.6)[e]	5.3(2.9) [+]	4.7(2.9) **	4.7(3.0) *	4.7(3.2)[+]	<0.05	<0.05	<0.005
SARS regular	$n = 44$	7.9(3.7)	7.2(3.9)*	6.2(3.6)***	6.0(3.6)	5.5(4.0)			
CCU	$n = 15$	4.1(1.4)[d]	4.9(1.6) [+]	4.7(2.3)	5.9(3.5)[+]	5.8(3.7) [+]			
Neurology	$n = 17$	3.9(1.3)[d]	4.9(2.2) *	4.0(2.3)	4.5(2.5)	4.1(2.7)			

BDI: beck depression inventory; STAI: Spielberger trait anxiety inventory; DTS-C: Chinese version of the Davidson trauma scale; PSQI: Pittsburgh sleep quality index.
Compared to D0 symptom ratings: ***$p < 0.001$, **$p < 0.01$, *$p < 0.05$, +$p < 0.1$, NS: non-significant.
Compared to D0 symptom ratings: [a]$p < 0.1$ vs. SARS ICU; [b]$p < 0.005$ vs. SARS regular; [c]$p < 0.05$ vs. SARS regular.
Compared to PSQI ratings: [d]$p < 0.001$ vs. SARS regular; [e]$p < 0.1$ vs. SARS regular.

was greater in both SARS ICU and regular SARS unit groups than in CCU (post hoc test: $p < 0.1$ and $p < 0.005$, respectively), but not different from that of the Neurology unit subjects, whereas no differences were observed among the four groups at the end of the study. The time by group interaction effect was reflected mainly by greater reduction of anxiety in both SARS unit groups (12–17%), in contrast to no change in the Neurology group and slight decrease in anxiety score (6%) in the CCU group. These anxiety symptom changes paralleled changes in depression ratings in all four groups except the Neurology group, in which mild anxiety was maintained throughout the study period.

4.3. Post-traumatic stress symptoms

The prevalence of symptomatic PTSD (DTS-C $\geqslant 23$ at any time point) was calculated as 33% ($N = 23$) for the SARS units (SARS ICU 38.5% [$N = 10$], regular SARS unit 29.5% [$N = 13$]) and 19% ($N = 6$) for the non-SARS units (CCU 11.8% [$N = 2$], Neurology unit 26.7% [$N = 4$]) (Table 2). There was no significant between-group (SARS vs. non-SARS unit) difference in the prevalence rate of symptomatic PTSD ($p = $ NS), yet, three unit subjects (SARS ICU, SARS regular, and Neurology) had higher rate of symptomatic PTSD

than those of CCU, implying that nurses not only at the SARS units but also outside the SARS unit with uncertainty for displacement might experience more post-traumatic stress symptoms during the outbreak.

ANOVA-R revealed a significant time effect ($F_{3,98} = 10.8$, $p < 0.001$) on reducing DTS-C symptom ratings (Table 3), reflecting 50% decrease in PTSD symptom scores at the end of the study for each group. There was also a group (SARS vs. non-SARS unit) effect ($F_{1,100} = 3.9$, $p = 0.05$), indicating that SARS unit nurses had higher DTS-C score for the 4-week period than non-SARS unit nurses. However, there was no time and group interaction effect, which implied the same magnitude of decrease for both SARS and non-SARS group subjects.

5. Sleep disturbances

5.1. Insomnia rate

Table 2 shows a significant effect of SARS unit on insomnia (lasting longer than 2 weeks) prevalence rate ($X^2 = 12.0$, df = 3,1, $p < 0.01$). The rate of insomnia was fourfold higher among SARS unit nurses than non-SARS unit nurses (37.1% vs. 9.4%, respectively).
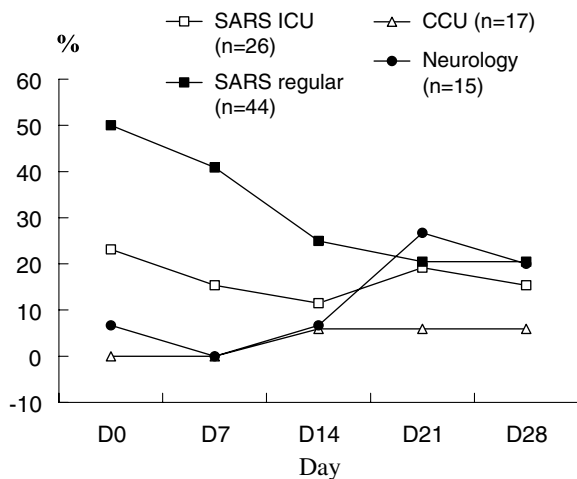
Fig. 1. Comparison of insomnia rate of nursing staffs during SARS outbreak, SARS vs. non-SARS units. D0: $X^2 = 20.7$, df = 1.3, $p < 0.001$; D7 : $X^2 = 19.1$, df = 1.3, $p < 0.001$; D14, D21, D28: $X^2 = 2.0$–5.4, df = 1.3, p = non-significant.

More of a trend toward greater insomnia rate was found in regular SARS unit subjects than in SARS ICU subjects, and more of a trend was also found in Neurology unit subjects than in CCU subjects ($p < 0.1$).

Further, Fisher exact test demonstrated significant differences in a 4 (group) × 5 (time) matrix ($X^2 = 20.7$, df = 3, 4, $p < 0.001$) (Fig. 1). At D0 and D7, significant insomnia rate was found in the SARS care groups ($X^2 = 20.7$ and 19.1, respectively, df = 1, 3, $p < 0.001$). The highest insomnia rate was found in the regular SARS unit (50% and 41%, respectively), followed by the SARS ICU (23% and 15.4%, respectively), and non-SARS units (0% and 3.1%, respectively). Nonetheless, from the D14 to the D28 endpoint, there were no significant differences in insomnia rate between these four groups ($X^2 = 5.4$, 2.6, and 2.0 for D14, D21, and D28, respectively, df = 1,3, p = NS). The insomnia rate in the regular SARS unit and SARS ICU remained at 20% and around 15%, respectively, whereas it was 6% in the CCU and went up to 20% or above in the Neurology unit. These findings showed that, at the end of study, CCU nurses had the least anxiety and lowest insomnia rate while Neurology unit nurses became more anxious and sleepless. By the beginning of the third week, sleep disturbance rates in both SARS unit groups had stabilized, with insomnia persisting in 1/6 to 1/5 for the remaining 2 weeks of the study.

5.2. Sleep quality

Significant effect of time ($F_{4,95} = 3.2$, $p < 0.05$), group ($F_{3,98} = 3.4$, $p < 0.05$), and time by group interaction ($F_{12,291} = 2.6$, $p < 0.005$) on changing sleep quality measured by PSQI was demonstrated (Table 3). At the D0

time point, nurses in the regular SARS unit had poorer sleep quality than those in the SARS ICU and non-SARS units (one-way ANOVA, $F_{3,98} = 11.3$, $p < 0.001$). However, sleep quality improved by 22% in the SARS ICU nurses and 30% in the regular SARS unit nurses, while sleep quality in the Neurology unit nurses significantly worsened (by 45%) at the D28 time point ($p < 0.1$). CCU nurses had good sleep quality during the whole study period. At the end point, the sleep quality of nurses in both regular SARS and Neurology units had not returned to normal (i.e., PSQI below 5; Buysse et al., 1988); average PSQI = 5.5 and 5.8, respectively. The analysis of overall group effects revealed that sleep quality was best in CCU nurses (PSQI 4.3 [SD 0.7]), followed by Neurology unit nurses (PSQI 5.0 [SD 0.7]), and SARS ICU nurses (PSQI 5.1 [SD 0.5]). SARS regular unit nurses had the poorest sleep quality (PSQI 6.5 [SD 0.4]).

The congruence of the insomnia rate and sleep quality data illustrated the following: (1) nurses working in SARS units during the peak SARS outbreak had the poorer sleep to start with and (2) nurses working in more structured environments such as the SARS ICU or CCU may have better quality sleep than regular SARS or Neurology unit nurses.

6. Changes in attitude towards the SARS outbreak in the SARS unit subjects (Table 4)

6.1. Knowledge and understanding of SARS

Significant time effect ($F_{4,65} = 22.4$, $p < 0.001$) but no group and group by time effect on increasing knowledge of the disease and of SARS-related issues suggested that there were no differences in improving comprehension of SARS between the SARS ICU and regular unit nurses. During the one-month period of observation, there was a 25% improvement in understanding of SARS, from the level of little or more (1.62 [SD 0.6]) to fair or more (2.1 [SD 0.1]), for the nurses in both SARS units.

6.2. Perceived negative feelings towards SARS

There were also significant time ($F_{4,65} = 32.9$, $p < 0.001$) and time by group interaction effects ($F_{4,65} = 3.2$, $p < 0.05$) but no group effect on reducing negative feelings (such as fears, anxiety and pressure, panic, depression and hopelessness, and loss of control). Negative perceptions of SARS improved in both the SARS ICU and regular SARS unit nurses (44% vs. 47%, respectively). Time by group interaction effect was reflected by faster reduction in negative feelings at D7 in the regular SARS unit than SARS ICU nurses (25% vs. 7%, respectively).

Table 4
Attitude towards SARS outbreak (scales 0–3), SARS ICU vs. SARS regular unit subjects ($N = 70$)

Subjective experience	Nursing units		D0 Mean (SD)	D7 Mean (SD)	D14 Mean (SD)	D21 Mean (SD)	D28 Mean (SD)	p Time	Group	time × group
Knowledge and understanding of SARS	SARS ICU	(n = 26)	1.6(0.5)	2.0(0.5)***	2.2(0.5)***	2.3(0.6)***	2.4(0.6)***	<0.001	NS	NS
	SARS regular	(n = 44)	1.6(0.7)	2.0(0.5)***	2.1(0.4)***	2.2(0.4)***	2.3(0.4)***			
Perceived negative feelings	SARS ICU	(n = 26)	1.5(0.5)	1.4(0.5)	1.1(0.5)**	1.1(0.5)***	0.8(0.5)***	<0.001	NS	<0.05
	SARS regular	(n = 44)	1.6(0.6)	1.2(0.6)***	1.1(0.6)***	0.9(0.5)***	0.9(0.6)***			
Positive attitudes	SARS ICU	(n = 26)	2.1(0.6)	2.2(0.5)	2.2(0.5)	2.3(0.5)*	2.3(0.6)	<0.001	NS	NS
	SARS regular	(n = 44)	2.1(0.5)	2.2(0.5)	2.2(0.5)	2.2(0.5)	2.3(0.5)*			

Compared to D0 rating: ***$p < 0.001$, **$p < 0.01$, *$p < 0.05$, NS: non-significant.

6.3. Positive attitudes towards caring for SARS patients

Although only a time effect ($F_{4.65} = 3.6$, $p < 0.01$) on enhancing positive attitudes toward SARS patient care was elicited, both groups of nurses had fair or high levels of family support, personal learning, and willingness to participate in SARS care at baseline (2.1 [SD 0.5]) and throughout the study period (2.3 [SD 0.5]).

6.4. Correlations between the attitude scale and STAI, BDI and DTS-C

There were positive correlations of perceived negative feelings ($r = 0.45$–0.74, $p < 0.001$) and negative correlations of positive attitude ($r = -0.27$ to -0.62, $p < 0.03$) with STAI, BDI and DTS-C score at D0, D14, and D28. These data suggested that greater positive attitude and less negative feelings toward SARS patient care might be associated with less psychiatric morbidity. Furthermore, increasing positive attitude was also associated with lessening of perceived negative feelings from D0 to D14 ($r = -0.43$, $p < 0.001$) and D14 to D28 ($r = -0.32$, $p < 0.01$), suggesting that continuous positive coping behavior might enhance protection against stress.

7. Work, social and leisure activity, and family life for the SARS unit subjects

For nurses in both SARS units, there was only a significant time effect on reducing Sheehan's disability scale mean score ($F_{1,68} = 4.0$, $p < 0.05$), indicating modest improvement in mild deficit of functioning level (from 2.7 [SD 2.5] to 2.1 [SD 1.9]). This improvement was accounted for by decreasing work and family life stress, and increasing social and leisure activity at the end of study.

8. Family support for the SARS unit subjects

Nurses in both SARS units received family support either always or most of time (mean family APGAR score (1.8 [SD 0.8])) throughout the whole study period with no time effect, implying that the study subjects in the SARS units, in general, were not neglected or rejected at all.

9. Psychiatric diagnosis

To validate the above assessment of symptomatic psychiatric morbidity, a MINI International Neuropsychiatric Interview (MINI) (Sheehan et al., 1998) and semi-structured interview was conducted by two

psychiatrists (TP Su, CY Yang) in person within one month after the end of the study. Twelve subjects (11%) were depressed (i.e., had major depression [$N = 6$] or adjustment disorder/depressive disorder, not otherwise specified [NOS; $N = 6$]), including 5 from the SARS ICU, 7 from the regular SARS units, and none from CCU or the Neurology unit (Table 1). About 20% ($N = 20$) of all subjects in this study had a past history of mood disorders. Of these, 30% ($N = 6$) developed current depression in contrast to only 7.3% ($N = 6$) of those with no past mood disorder history ($X^2 = 8.0$, df $= 1,1$, $p < 0.01$). On the other hand, none of the remaining 70% ($N = 14$) with previous depression history working in non-SARS units developed depression during the study period, indicating that 100% of those with past depression had symptomatic relapse when placed in this overwhelmingly stressful environment. Though the DTS-C detected 29 cases of symptomatic PTSD, the MINI found that none met the criteria for PTSD after the study period was over.

10. Difference in mood symptom ratings, sleep quality, and insomnia rate between MINI-diagnosed depressed and non-depressed subjects in the SARS units

Table 5 shows that there were significant effects of time (D0-D28) ($F_{4,65} = 3.9$–9.9, all $p < 0.02$), group (depressed vs. non-depressed) ($F_{1,68} = 18.3$–25.2, all $p < 0.001$), but no time by group interaction on the changes in BDI-, STAI- and DTS-C-rated mood symptoms. Similar results were found in insomnia rate and

PSQI with a significant time ($F_{4.65} = 5.8$, $p < 0.001$) and group effect ($F_{1,68} = 10.2$, $p < 0.005$). These data revealed that the mood symptoms and sleep disturbance of either depressed or non-depressed subjects in the SARS units were decreased as function of time. However, a significant group effect for all the above parameters reflected that the depressed subjects were more symptomatic than the non-depressed subjects overall during the study period and also at every follow-up time point (one-way ANOVA, $F_{1,68} = 6.0$-26.2, all $p < 0.05$). Insomnia rate was two- to threefold greater in the depressed than non-depressed subjects. Apparently, a mild degree of depression, anxiety, and post-traumatic symptoms, and a moderate level of sleep disturbance had remained in depressed subjects at the end of the study.

11. Risk factors for depressive disorder (MINI diagnosis), symptomatic PTSD, and insomnia

Multivariate logistic regression for SARS unit subjects only revealed that previous history of mood disorders might predict the occurrence of depressive disorder (MINI) and insomnia with odds ratio of 5.6 (95%CI 1.3–23.9) and 8.5 (95%CI 2.1–34.2), respectively (Table 6). Age less than 30 years was a high risk for depression (MINI) (odds ratio 21.4 [95%CI 2.8-165]). Perceived negative feelings towards SARS at baseline was highly associated with symptomatic PTSD and insomnia (odds ratio 11.1 and 3.5 with 95%CI 2.3–53 and 1–12.5, respectively), while positive attitude towards SARS was associated with decreasing depression (odds ratio

Table 5
Comparison of mood symptom ratings, sleep quality and insomnia rate between depressed and non-depressed group in the SARS units

Diagnosis group by MINI		D0	D7	D14	D21	D28	ANOVA-R (p)		
		Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Time	Group	Time × group
BDI									
Depressed	$n = 12$	14.7(6.9)[a]	13.2(7.2)[a]	14.0(10.3)[a]	10.9(10.3)[a]	11.5(6.9)[a]	<0.01	<0.001	NS
Non-depressed	$n = 58$	8.6(6.1)	6.4(5.7)	5.7(5.2)	4.6(4.4)	4.2(3.9)			
STAI									
Depressed	$n = 12$	59.7(7.5)[b]	57.1(7.7)[a]	52.9(5.8)[a]	49.0(6.1)[a]	50.4(6.7)[a]	<0.001	<0.001	NS
Non-depressed	$n = 58$	45.2(10.2)	43.2(10.2)	41.2(10.4)	38.9(9.7)	38.3(8.5)			
DTS-C									
Depressed	$n = 12$	25.3(13.1)[b]		20.4(12.8)[b]		20.6(13.1)[a]	<0.02	<0.001	NS
Non-depressed	$n = 58$	14.1(10.9)		10.7(10.5)		7.4(7.3)			
PSQI									
Depressed	$n = 12$	9.5(4.2)[c]	8.7(3.0)[c]	8.1(3.3)[b]	7.7(2.6)[c]	8.7(2.9)[a]	<0.001	<0.005	NS
Non-depressed	$n = 58$	6.8(3.1)	6.0(3.6)	5.1(3.3)	5.1(3.4)	4.5(3.5)			
Insomnia rate									
Depressed	$n = 12$	75%	50%	41.7%	41.7%	41.7%	X^2 test (p)		
Non-depressed	$n = 58$	32.8%	27.6%	15.5%	15.5%	13.8%	D0 < 0.01	D7 = 0.1	D14–28 < 0.05

BDI: beck depression inventory; STAI: Spielberger trait anxiety inventory; DTS-C: Chinese version of the Davidson trauma scale; PSQI: Pittsburgh sleep quality index.
Compared to non-depressed group: [a]$p < 0.001$, [b]$p < 0.01$, [c]$p < 0.05$, NS: non-significant.

Table 6
Risk factors for current affective disorder and insomnia

Current depression (MINI)	Odds ratio	95% CI	p
Past history of mood disorder	5.6	1.3–23.9	<0.05
Age < 29 years	21.4	2.8–165.5	<0.01
Positive attitude towards SARS	12.7	1.1–150	<0.05
Symptomatic PTSD			
Perceived negative feeling towards SARS	11.1	2.3–52.9	<0.005
Insomnia			
Past history of mood disorder	8.5	2.1–34.2	<0.005
Perceived negative feeling towards SARS	3.5	1.0–12.5	<0.1

MINI: psychiatric diagnosis by Mini International diagnosis for Neuropsychiatric Interview.
PTSD: post-traumatic stress disorder.

12.7, 95%CI 1.1–150). Interestingly, a comparison of all four groups by regression analysis showed that working in the SARS unit might strongly predict sleep disturbance during the initial period (odds ratio 20.3 [95%CI 2.5–162]).

12. Discussion

Natural disasters, like earthquakes, are associated with high prevalence of mental disturbances, including PTSD, major depression, and insomnia (the disturbances to receive the most attention) (Chou et al., 2005; Goenjian et al., 2000; Mellman et al., 1995). Since the SARS outbreak was a bio-disaster (Chong et al., 2004) with profound psychological effects on health workers, our study focused on its psychiatric consequences in nurses. To our knowledge, the design of this SARS outbreak study is unique. Different from the cross-sectional and retrospective models used in most studies (Maunder et al., 2003; Sim et al., 2004; Chua et al., 2004; Chan and Huak, 2004; Chen et al., 2005; Chong et al., 2004), this study design performs three key functions, it: (1) analyzes prospective, periodic, and naturalistic data; (2) compares experimental (SARS) vs. non-experimental (non-SARS) units; and (3) makes comparisons at two levels of work environment structure (more structured environments with more severely affected patients vs. less structured environments with less severely affected patients).

An acute overwhelming stress might induce rapid changes in psychological status. Detecting these changes in the acute phase would enhance our understanding of coping strategies and improve our ability to provide assistance. Therefore, repeated clinical assessment within a short timeframe was needed. Despite the difficulties inherent in studying SARS unit nurses, the goal was accomplished with the drop out of only a few subjects from the study.

The main results of this study were (1) about one third or more of the nurses caring for SARS patients developed symptomatic depression, PTSD, and insomnia in contrast to the lower prevalence of these problems in non-SARS unit nurses; (2) gradual adaptation to stress and decline in psychological symptoms and sleep disturbances were observed during the 4-week study with almost no differences in mood symptom levels between SARS and non-SARS unit subjects at the end point; (3) changes in attitudes towards SARS were similar (i.e., knowledge of SARS increased, perceived negative feelings decreased, and positive attitudes increased); (4) the functioning of these nurses in family, work, social, and leisure activities improved as a function of time, all having received the support of their family during this period; and (5) working in SARS units was the main risk factor for the occurrence of mood symptoms and insomnia. Previous history of mood disorder and age less than 30 years old may also be risks for predicting depression, post-traumatic stress symptoms and sleep disturbances.

Using the BDI depression rating, 27.5% of our total study nurses were symptomatically depressed, similar to the rate of depression in the quarantined persons (31.2%) in Toronto (Hawryluck et al., 2004) and also to the psychiatric morbidity (20–30%) of the HCWs (rated on the GHQ) during the SARS outbreak (Sim et al., 2004; Chan and Huak, 2004). Only one report found that the prevalence of psychiatric morbidity was up to 75.3% (Chong et al., 2004). The much higher rate was attributed to the shock elicited by the sudden, rapid spread of the disease from the northern part of Taiwan to the south without warning. At the time of the second SARS peak, these workers experienced fears and anxiety, and had little control over the infection. In contrast, the much lower rate (38.5%) of depression in our SARS unit nurses might be explained by using a different assessment tool and by the timing of the study, which was three weeks after the first peak of SARS infection in the northern part of Taiwan and apparently sufficient time to become more adjusted to caring for SARS-infected patients and feel less fearful. Their work environment was also more structured and safer than it had been during the first peak of the outbreak. Nevertheless, these SARS unit subjects still had a higher rate of depression than non-SARS unit subjects (3.1%). This difference was not as striking as the one for PTSD. Although symptomatic PTSD occurred more frequently in the SARS unit nurses (33%) than non-SARS unit nurses (18.7%), its prevalence rate in regular SARS unit (29.5%) and Neurology unit (26.7%) nurses was equal, implying that the psychological impact of the SARS outbreak on the latter (even though not working with SARS patients) might be significant. This higher symptomatic PTSD rate might have been because of uncertainty over being recruited into SARS patient care in

the near future. That nurses of CCU experienced the least PTSD symptoms (11.8%) might be explained by absence of this uncertainty. Overall, the prevalence of symptomatic PTSD for all nurses studied was 28.4%, which was equal to the rate of the quarantined group in Toronto (Hawryluck et al., 2004) but higher than the rates found by other studies (9.4–20%) (Sim et al., 2004; Chan and Huak, 2004). Different assessment timing and instruments may account for these differences. Our assessment was performed concurrently with the SARS epidemic while the assessments of other studies were delayed and retrospective. We used the Davidson trauma scale (Chen et al., 2001) to assess PTSD symptoms, while others used the impact of event scale.

So far, only one study has systematically investigated the effect of SARS on sleep disturbance and revealed around 50% developed insomnia (Chong et al., 2004). Our study found a robust effect of working in the SARS units, i.e., insomnia rate four-fold higher (37.1%) in the SARS units than in the non-SARS units (9.4%). Working in the regular SARS unit and SARS ICU resulted in 50% and 23% insomnia rate at the baseline and 41% and 15.4% at the end of the first week, respectively. On the other hand, no insomnia occurred at all in the initial phase for non-SARS unit nurses. High insomnia rate might be a better initial indicator than other mood changes of psychiatric morbidity stemming from SARS-care-related stress. The interpretation was more valid for regular SARS unit nurses than SARS ICU nurses, as the former were less experienced and worked in a less structured environment. Sleep quality differed between the four groups of nurses, with the poorest sleep quality being in the regular SARS unit nurses followed by the SARS ICU, Neurology, and CCU nurses. However, this striking stress-related marker disappeared on the second week and thereafter, suggesting that insomnia with poor sleep quality was a short and temporary response to stress. The duration of stress-induced insomnia is related to the magnitude of the stress and associated environmental factors. For instance, the Chi–Chi earthquake-induced elevation of insomnia rate in Taiwan lasted 3–6 months (unpublished data).

This longitudinal periodic study has demonstrated a time effect and a group effect of SARS on depression, anxiety, PTSD, and sleep disturbance. Time effect indicates a gradual symptom (35–65%) reduction from baseline, which reflects greater psychological adaptation. The psychological adaptation of the SARS unit nurses might be related to increasing knowledge of the disease per se, increasing experience with managing SARS patients, decreasing perceived negative feelings, and continuous positive coping behavior over time. The group effect means that the SARS unit nurses were more symptomatic than the non-SARS unit nurses. The difference was significantly greater at the beginning than at the end of the study when no differences in

symptoms between four groups were observed. One study (Chong et al., 2004) found anxiety and worrying in the initial 2 weeks (chaotic condition) and depression and avoidance in the last 2 weeks (stable condition). Which of these symptoms occurred depended on the phase of the infection (initial vs. repair phase of the disease). In addition, this study was cross-sectional and the study groups in the initial and repair phase were not the same. Our study followed the same study subjects throughout the study and found anxiety, depression, PTSD, and insomnia in the initial 2 weeks but not in the latter phase. The initial appearance of these behavioral symptoms was mainly due to working in the SARS units and caring for SARS patients. The one exception (Neurology unit nurses who had a higher insomnia rate and poorer sleep quality after the third week than at baseline) may have been due to uncertainty over their work destination.

To validate the psychiatric diagnosis, a MINI diagnostic interview was conducted one month after the study. Despite the high prevalence of symptomatic PTSD during the SARS outbreak, MINI found no PSTD. Incidence of MINI-diagnosed depressive disorder was also lower than symptomatic depression in the SARS units during the outbreak (11% vs. 38.5%, respectively). The discrepancy was thought to be due to fact that (1) the MINI diagnosis is retrospective and therefore less accurate because it is memory-dependent; (2) the MINI may fail to detect symptomatic PTSD that is acute, transient, and less severe, favoring the diagnosis of acute stress reaction; and (3) rate of questionnaire-based diagnosis is much higher than that of face-to-face interview-based diagnosis. Despite these shortcomings, MINI may be the more valid diagnostic method to use over the entire study period. Therefore, when depressed ($n = 12$) and non-depressed SARS unit nurses ($n = 58$) were compared, the depressed group had greater depression, anxiety, and sleep disturbances at entry and throughout the entire period. They remained mildly anxious and depressed and had high insomnia rate (50%) even at the end point. On the other hand, the level of mood and sleep disturbance in the non-depressed group was similar to that of the non-SARS unit group during the whole study, suggesting that the symptoms of the depressed group may account for most of the behavioral disturbances elicited in SARS unit nurses. This observation may imply that early intervention, either psychological or medical, is needed.

The effect of dose (SARS vs. non-SARS) and structure (more vs. less) on change in mood and sleep symptoms was apparent. The dose effect was suggested by the greater psychiatric morbidity of SARS unit than non-SARS unit subjects. Clearly, nurses who provided SARS care faced a life threatening and uncertain situation and so became more symptomatic than their non-SARS counterparts. The effect of structure was

suggested by the lower morbidity found in the subjects who worked in the more structured environment (i.e., the SARS ICU nurses). To our surprise, insomnia was less marked in nurses who took care of the more severely affected or intubated SARS patients than in nurses who cared for the less severely affected SARS patients. A similar relationship was observed in CCU vs. Neurology unit nurses. Explanations for this paradoxical finding may be (1) SARS is easier to deal with in an ICU and patients in ICU have fewer individual and emotional requirements; (2) the environment of SARS ICU is more structured, the work more routine, and the goals of patient care more certain; (3) all of the SARS ICU nurses were from the respiratory therapy care unit (RTCU), and therefore skilled in the care of patients with respiratory failure, while the regular SARS unit nurses came from different wards of the hospital rendering them more vulnerable to this heavy stress. The same explanations were also applicable to non-SARS units.

The most important risk factor linked to psychiatric morbidity and sleep disturbance in this study was contact with SARS patients. Two studies from Taiwan (Chen et al., 2005; Chong et al., 2004), but none from Singapore concluded similarly (Sim et al., 2004; Chan and Huak, 2004). One study (Chan and Huak, 2004) explained that all the suspect or probable cases of SARS were transferred immediately upon diagnosis to a SARS-designated hospital. The hospital studied was not the designated one, and only a small number of SARS patients were identified there. Perhaps the limited contact with SARS patients in that hospital resulted in failure to observe the link between psychiatric morbidity, sleep disturbance, and contact with SARS patients. The other study (Sim et al., 2004) suggested that the post-traumatic morbidity was a reflection of a complex psychosocial response, which was affected by not only direct exposure but also other contextual factors (Kroll, 2003). Younger age (less than 30 years) was the risk factor in both ours and Sim's study (Sim et al., 2004), while the length of work experience was not identified as a risk factor in other SARS studies (Sim et al., 2004; Chong et al., 2004) and in this study as well. In our study, previous history of mood disorders, positive attitude, and perceived negative feelings towards SARS were of particular interest. Previous studies had difficulty determining past history of mood disorders (Sim et al., 2004; Chan and Huak, 2004; Chong et al., 2004). But it is certainly a predictor, and caution should be used when putting subjects with past psychiatric history in highly stressful situations. On the other hand, coping strategies and efforts were found to moderate the psychological impact of highly stressful conditions. Staff with psychiatric comorbidity coped more frequently by using strategies based on negative feelings such as fears (Maunder et al., 2003; Masur et al., 2003; Lew et al., 2003), denial, and uncertainty (Maguire and Faulkner, 1988). Fortunately, our staffs had negative perception only initially and their positive attitudes were maintained throughout the whole study.

A longitudinal prospective study in disaster disclosed that the availability of social support has been found to reduce subsequent post-traumatic symptomatology (Joseph et al., 1993). Financial loss and social network changes after earthquake were also risk factors for psychiatric morbidity almost a year after (Chou et al., 2004). During the SARS outbreak, better coping behaviors such as venting negative emotions, open communication with personal distress within a supportive environment (peer groups or family) facilitated greater acceptance of their situation and reduce psychological morbidity (Sim et al., 2004). Lower family APGAR score indicates strong family support. Our study subjects were able to share feelings with, to discuss things with, to get help and care from their family members while facing an overwhelming and fearful condition. This important factor may contribute to rapid adaptation to the stressful working environment and maintaining stable work functioning levels, social/leisure activity and family life.

This study had several limitations. First, the pre-SARS psychiatric history and objective MINI diagnosis were obtained retrospectively, within a month after the study was finished. The results did not reflect the real time psychiatric morbidity. Second, anxiety, depression, and PTSD were all rated in real time, but the ratings were subjective and therefore might reflect bias. Third, since the study was conducted mainly in SARS unit in the general hospital setting, the findings may not generalizable to HCWs in other medical units as well as in the community such as family physician and local clinics. Also, it may not be applicable to male HCWs since all the study subjects are females in this special study. Fourth, the psychological adaptation seemed to occur as the epidemic declined. However, still unclear is whether psychological adaptation would have occurred if the outbreak had continued to worsen.

To summarize, this naturalistic observation study has demonstrated that providing a safe and well-structured work environment will minimize the acute stress effect of a bio-disaster and foster resilience of health care workers' mental status. Sleep disturbance, the earliest and most prominent symptom to reflect difficulties in adjusting to acute stress, requires immediate management. To face future highly stressful bio-disaster condition, selection of the caring medical staffs should be cautious, avoiding those who have past history of psychiatric disorder. For the younger and less experienced workers, alternatively, strong psychological support and counseling should be offered.

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